International Journal of Scientific Research and Engineering Development-– Volume 3 - Issue 5, Sep - Oct 2020

Available at www.ijsred.com

RESEARCH ARTICLE OPEN ACCESS

STAINLESS-STEEL ELEVATED WATER TANKS FOR THEGHANDRAN VILLAGE SITUATED IN PUNJAB, INDIA

Lakshay Sharma, Monika Verma

(Student, Civil Engineering, Lovely Professional University, Jalandhar, Punjab, India
Email: lakshaylpu@gmail.com),
(Assistant Professor, Civil Engineering, Lovely Professional University, Jalandhar, Punjab, India
Email: monika.25114@lpu.co.in)

----------**********----------

Abstract:

In the Pandemic like SARS CoV-19, we have learnt about hygiene and how to be hygienic. But there issome kind of a problem related to the water tanks made up of concrete that they are not hygienic. The stored water gets easily contaminated because of no maintenance. The walls are not properly caulked because of which cracks and discoloring of walls occur which causes annoyance to our eyes. Contaminated water can cause water-borne diseases like, Cholera and when contaminated water is stored in such a massive amount it can cause a huge loss to our community.

So, the problem is water tank construction material which is Reinforced cement concrete. This research paper reports the analysis and design of a stainless-steel elevated water tanks, which is a proposed solution to an existing R.C.C water tank situated in Ghandran village which comes under Pathankot district in Punjab, India.

Keywords **—SARS CoV-19 (Serve Acute Respiratory Syndrome Coronavirus disease of 2019),R.C.C(Reinforced Cement Concrete), STAAD.PRO- Structural Analysis and Designing Program.**

----------**********----------

I. INTRODUCTION

Water might be put away in common or counterfeit lakes, supplies, standpipes, or raised tanks. The framework utilized is generally controlled by nearby conditions and the reason for which the capacity is needed.

For water system purposes where a huge volume of water is required, it is the typical custom, without a characteristic waterway, to fabricate dams shaping a fake lake. These lakes are conventionally at adequate rise to empower the conveyance of the water by gravity stream. They are filled during the wet season from the surface water originating from higher rises, and are constructed huge enough to outfit a gracefully over the dry time of the year. A more modest volume of water is needed as the save flexibly to a water works plant or fire insurance framework, it might be put away in steel or solid supplies. The size of the steel store is restricted in any case, because of the plates turning out to be thick to such an extent that they can't be rolled and punched monetarily. Concrete is being utilized impressively for the development of huge repositories; yet so far has not demonstrated acceptable when worked over the ground, because of not remaining water tight. This causes breaks from freezing; and a staining of the external dividers, which is disappointing to the eye.

The solid development is expensive, has the hindrance of being hard to make water tight, and isn't a triumph from a structural perspective. The topic of predominance of steel over wood for building tanks is a similar that applies to scaffolds, structures and numerous different structures. Once

in the past they were totally worked of wood, yet now are being fabricated essentially of steel. The chief preferences of steel development are more prominent sturdiness and more noteworthy quality of material. The steel tank remains totally water tight, when appropriately caulked, while the wooden tank will ceaselessly give inconvenience by spilling. The life of the steel tank is more than two-fold that of the wooden tank, and the expense of the two is basically the equivalent.

II. OBJECTIVE

Main objective of this study is to develop, design and analyse the Stainless-Steel Water tank in STAAD.PRO. This study also talks about new type of water tank which is made up of stainless steel. The shape of water tank is smooth and economical. Its lightweight, high-strength, high-corrosion, high-temperature resistance, clean water, anti-seepage, anti-vibration, no-maintenance and easy cleaning.

III. PLANNING

Planning consists of the steps in which population survey is done. Population census helps to calculate the daily consumption of water. The village population is 850 according to Sarpanch. Sarpanch is the head of the village elected by people.

A. WATER DEMAND

As per IS code, 135 litres water is needed for daily use per person per day. Breakup of the IS assumptions is like:

TABLE I
VOLUME OF WATER REQUIREMENT AS PER IS CODE

S.NO	WATER REQUIREMENT	
	Purpose	**Volume (in litres)**
1	Drinking	5
2	Cooking	5
3	Bathing & Toilet	85
4	Washing Clothes & Utensils	30
5	House Cleaning	10

So, the taken value of water demand for the village is 2,00,000 litres/day.

B. WATER TANK SHAPE &DIMENSIONS

Second step is to find the shape & dimensions of tank with the help of daily water consumption data.

There are two shapes available in market that are hemispherical or conical bottoms and other are having large diameter and shallow depth, the cylindrical one. So, the study chooses Cylindrical shape according to the capacity and water demand of the village.

Volume of water formula as 1 m^3 is equal to 1000 litres per day.
1 litre = 0.001 m^3
Our requirement is 2,00,000 litres,
Therefore, 2,00,000 litres = 200 m^3.

As we know that the shape of water tank is Cylindrical.

Volume of cylinder = $2\pi rh$
Assuming h= 5m which is the depth or height of the water tank.
From the above equation, V= $2\pi rh$,
Radius of water tank is 8m.

So, the water tank is design for 2,50,000 litres.

C. WATER TANK POST SELECTION

There are two types of posts are used in steel tanks:
Battered Posts used where we have to provide a great elevation with a stability to that structure.
Vertical Posts are used when the bottom of tank is elliptical and flat. It is generally used for railway services.
In this research, Vertical posts are used as per our location requirement for the stability of the structure.

D. WATER TANK FOUNDATION

This water tank is built on isolated footing which is a fixed support.

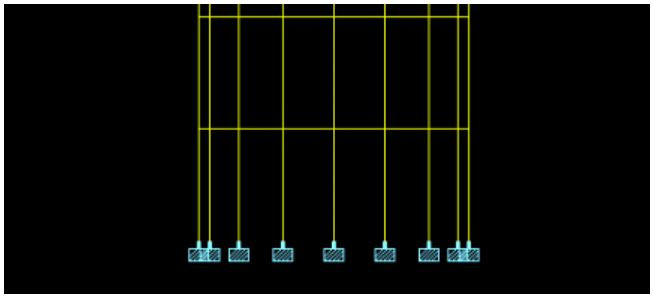

Fig. 1Water Tank foundation in STAAD-PRO.

E. WATER TANK LOAD CALCULATION

In this research, only two kinds of load analysis have done on steel structure, i.e. Dead load of the structure which is the self-weight of the structure itself.

Second is, Hydrostatic load which is the pressure caused by water itself occurred at the time of filling and emptying the tank.

$P = \rho g h$

ρ=density of water in K-N/m^3, which is 9.87K-N/m^3

g = acceleration to gravity in m/ sec^2, 9.8 m/ sec^2

h = depth or height of vertical struts of the tank, h = 15m.

So, the hydrostatic pressure comes out to be 150 K-N/ m^2.

IV. METHODOLOGY

In this research, STAAD-PRO software is used for the modelling and analysis of stainless-steel water tank with a 15 m elevation from the ground.

Result section shows that all beams and columns are pass after the analysis of structure.

A. Beam Designing and Analysis

There are two types of beams available in this tank; One is at the bottom of tank which will transfer dead load of the stainless-steel tank to the foundation through vertical posts. Figure.2 shows that our beam section is passed.

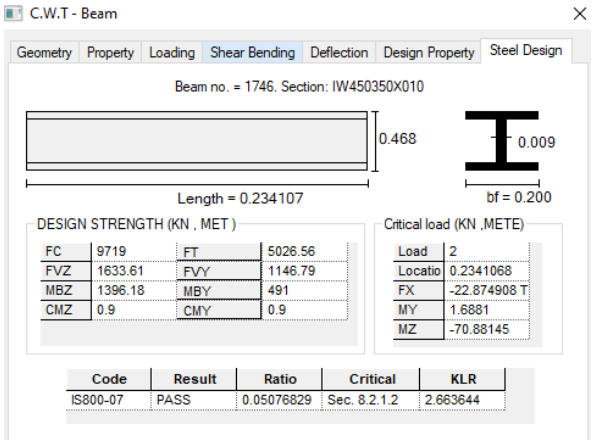

Fig. 2 Beam Designing and Analysis Values

Secondly horizontal Struts (they act like a beam) which are provided in between the vertical posts to give a great stability to steel structure.

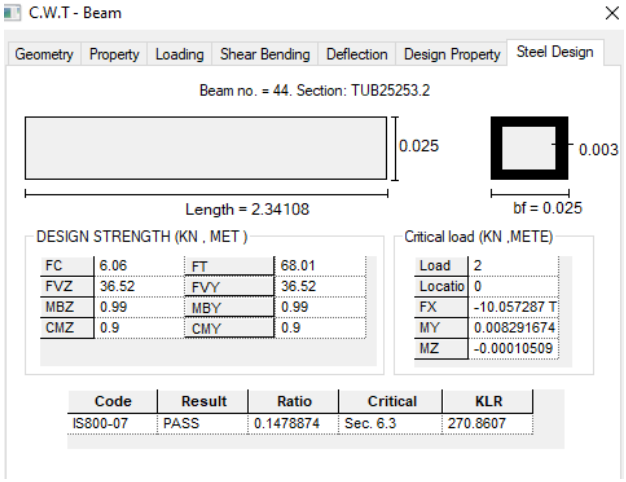

Fig. 3 Horizontal Strut Design and Analysis Values.

B. Column Designing and Analysis

Column-isolated footing is a type of foundation generally used in water tanks construction.

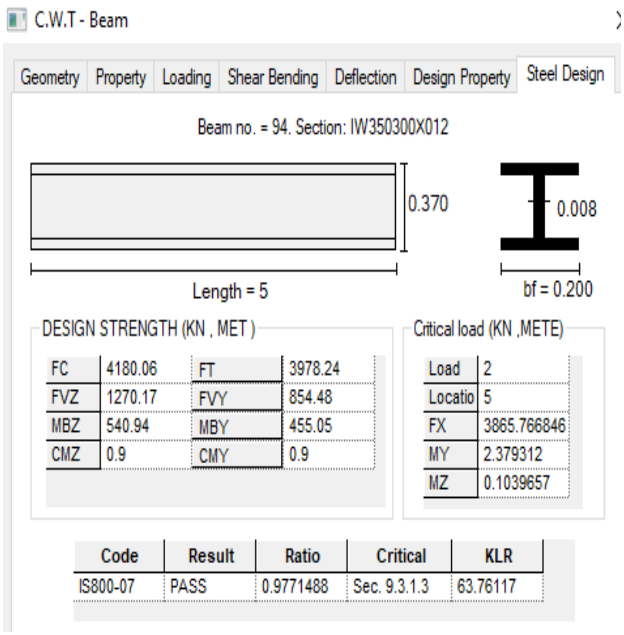

Fig. 4 Column Designing and Analysis Values.

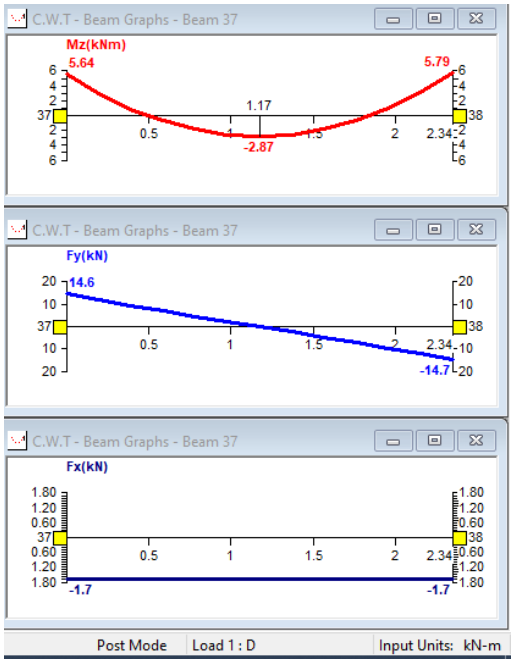

Fig. 5Bending Moment and shear force graphs.

V. RESULTS

A. Bending Moment and Shear Force Graphs

Shear force and Bending moment graphs are graphical representation used to check their values. This is a tool for structural engineers to perform their structural designing by determining the value of shear force and bending moment at a given section or at a point of a structural element such as a beam.

Figure 6 helps to understand the values of shear of shear force and bending moments for a particular direction and at a particular point.

B. Maximum Absolute Plate stress diagram

Figure 7 helps us to analyse the maximum absolute stress on plates. Stresses are differentiated with the help of colours.Red bottom surface of the tank shows the maximum absolute stress on plates because of hydrostatic pressure/stress on plates.

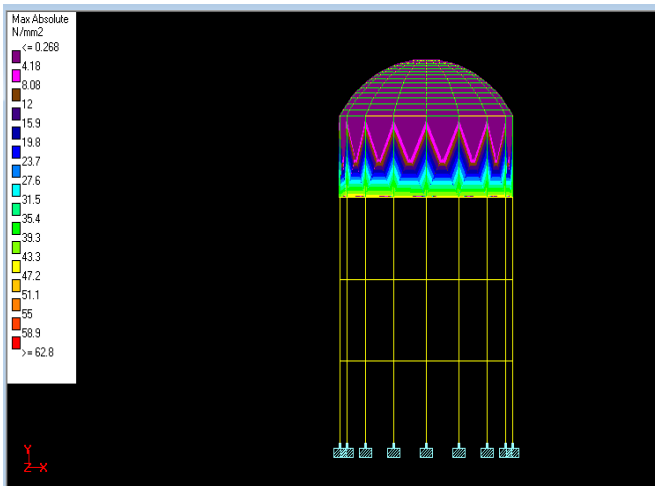

Fig. 6Maximum Absolute stress on plates.

VI. CONCLUSIONS

STAAD-PRO is a software which can easily perform analysis of structure according to different codes. This study has been as per IS:800(2007).
Various structural actionsare performed on the members under certain loading conditions. All the design values for beams, columns and plates are passed under stresses.
Stainless-steel water tank has wide application range: It is reasonable for industries, colleges and clinical and health industry.
Stainless-steel material has stable physical and compound properties, no contamination to water quality and guarantees perfect and clean water quality. The water tank has high quality, lightweight and an eye-satisfying appearance.

ACKNOWLEDGMENT

I would like to express my very extremely incredible thankfulness to Ms. Monika for her significant and helpful recommendations during the arranging and advancement of this examination work. Her readiness to give her time so liberally has been a lot of refreshing.

I would like to thank the staff and head of the village Panchayat for providing the census data.
Finally, I wish to thank my parents for their support and encouragement throughout my study.

REFERENCES

[1] Thalapathy. M, Vijaisarathi. R. P. Sudhakar. P. Sridharan. V, Satheesh. V. S (2016). "Analysis and Economical Design of Water Tanks". International Journal of Innovative Science, Engineering & Technology, Vol. 3, Issue 3 ISSN 23487968
[2] Nallanathel. M. Ramesh. B, Jagadeesh. L (2018). "Design and Analysis of Water Tanks using Staad-Pro" International Journal of Pure and Applied Mathematics, Vol. 119. No. 1730213029 pp, ISSN: 13143395 on-line version).url: http://www.acadpubl.eu/hub/Special Issue.
[3] Nikunj P, Mistry. J., "Analysis of Circular Water Tank Stresses Under Hydrostatic Loading by Using Staad-Pro
[4] IScode800-2007 – Code of practice for general construction in steel.
[5] IS code 875 (part 1) – Dead Load.

